CALCULATION COVER SHEET

WESTON
MANAGERS DESIGNERS/CONSULTANTS

Project:	**INEEL V-Tank Remediation Project**				**Number of Sheets:** 1 of 16
Site:	Test Area North, Idaho Falls, Idaho				
Calculation Number:	ABQ04-HP004		**Work Order Number:**	12393.002.001	
Subject:	**Required treatment calculation of liquid-phase tank waste in order to ensure compliance with the Waste Acceptance Criteria (WAC) for disposal at Envirocare of Utah**				
Rev #:	**Date:**	**Revision:**	**Calculated by:**	**Checked:**	**Approved:**
RAA	5/31/01	90% Design	Carla Rellergert	Berg Keshian	
RAB	6/27/01	90% Polish	Carla Rellergert	Berg Keshian	
RAC	9/27/01	Draft Final	Carla Rellergert	Berg Keshian	Jim Lockhart
RAD	10/23/01	Draft Final Polish	Julie Steffes	Dan Brennecke	Jim Lockhart 10/24/01

Problem Statement:

Utilizing provided characterization data from references, determine the required treatment necessary to allow the liquid phase of tank waste to be shipped and disposed of at Envirocare of Utah, Inc. Compare known constituent concentrations from the liquid phase of each V-Tank waste with applicable land disposal restrictions treatment standards and Envirocare's Radioactive Materials License.

Method of Solution:

A review of existing chemical data for the liquid phase (and solid phase) of each V-Tank was performed and highest constituent concentrations were input into Excel 2000 tables (Calculation # ABQ03-HP003-RAD). A preliminary liquid waste determination and summary is provided as referenced herein, and applicable regulatory limits as well as wastewater and non-wastewater LDR treatment standards were also entered into these tables. A review of existing radiological data for the liquid phase of each tank was performed. Based on the radionuclides detected in the waste, a comparison table was created between the activity detected for each radionuclide and the average concentration per container allowed at Envirocare based on their Radioactive Materials License.

Assumptions:

1. The contents of each tank will eventually be separated into liquid and sludge/solid phases and each phase will be managed separately based on highest constituent concentrations present in that phase of the waste.

2. Dilution of the tank waste will not occur during phase separation.

3. The wastewater determination for the liquid phase of each tank may change after the waste is removed based on total organic concentration as well as total suspended solids concentration.

4. This review does not evaluate the V-Tank waste for compliance with DOT or determine the radionuclide concentration estimated per DOT container.

5. This review does not include a determination of whether the waste is classified as a Class A, B or C waste.

6. This review does not include a determination of applying the sum of fractions rule for waste containing more than one radionuclide.

7. This review does not include a determination of whether the waste is considered special nuclear material as defined in the Utah Administrative Code R313-12-3.

8. With regards to the characterization data, when constituents were not detected and the detection limit was below the applicable LDR treatment standard or Envirocare's Radioactive Material's license, it was assumed that the constituent was not present in the waste and was not evaluated for purposes of compliance with RCRA, TSCA requirements, or with Envirocare's WAC.

9. With regards to the characterization data, the highest reported concentration for the waste reviewed was included in the summary tables for comparison against regulatory limits, LDR treatment standards and average radionuclide concentration per container.

10. With regards to the chemical and radiological characterization data, it was assumed that only those constituents analyzed are considered contaminants of concern for this waste.

11. With regards to the chemical characterization data, when a constituent was not detected and the detection limit exceeded either the regulatory limit or the LDR treatment standard limit, it was assumed that those constituents could still be present and were assigned a D code or included as underlying hazardous constituents (UHCs) requiring treatment.

12. It is recognized that additional organic constituents may be present below the detection limit, and this has been accounted for in the factor of safety applied to the design of the carbon absorption system.

13. With regards to the chemical characterization data, it was assumed that the presence of Trichloroethene is considered an F001 listed waste for all the V-Tank waste based on historical information. Trichloroethene is also considered the only listed hazardous constituent associated with the V-Tank waste.

14. With regards to the chemical and radiological characterization data, all reported analytical results were representative of each phase of V-Tank waste.

15. PCBs are not an issue for the liquid phase of the V-Tank waste and will not be considered for purposes of shipping this waste to Envirocare.

Sources of Formulas and References:

1. Wastewater definition: Wastes that contain less than 1% by weight total organic carbon (TOC) and less than 1% by weight total suspended solids (TSS). Reference: RCRA Regulations and Keyword Index, 2000 Edition, Chapter 8, "40 CFR Part 268: Land Disposal Restrictions", specifically, 40 CFR 268.2 (f).

Characterization Data From:

Comprehensive Remedial Investigation/Feasibility Study (RI/FS) *for Test Area North Operable Unit 1-10 at INEEL,* DOE/ID-10557, November 1997, Dept. of Energy/Idaho Operations Office, Idaho Falls, ID.

Waste Acceptance From:

Waste Acceptance Guidelines of Envirocare of Utah, Inc., 46 West Broadway, Suite 116, Salt Lake City, Utah 84101; September 30, 1999.

Agreement-State Radioactive Material License, License #UT 2300249, amendment #11, issued by the Utah Division of Radiation Control (DRC).

Calculation:

Refer to Calculation number ABQ03-HP003-RAD Excel tables labeled "INEEL V-Tank Number VOC (or SVOC, Inorganic, Miscellaneous or PCB) Analysis on either Solid or Liquid Phase."

Discussion:

Ultimately, the management and eventual treatment and disposal of waste associated with the removal of the V-Tanks, will be based on the characterization of the V-Tank waste. A preliminary chemical characterization of the V-Tank waste was performed based on the separation of waste phases. A summary of the results are reported below:

Tank	Chemical Constituents Requiring Treatment
V-1	Tetrachloroethane, Trichloroethene, Mercury, Lead, and UHCs.
V-2	Trichloroethene and UHCs
V-3	Trichloroethene and UHCs
V-9	Methylene chloride,1,1,1-Trichloroethane, Trichloroethene, several SVOCs, Cadmium, Mercury, Lead, Nickel, and UHCs.

Table 5 in Attachment 1 lists the SVOC analytical results for each of the tanks and the LDR treatment standards for each SVOC.

Additional radiological sampling and analysis may also be required after on-site treatment. Therefore, this characterization is based on preliminary information.

Summary

The existing analytical data associated with the liquid waste from each tank was reviewed and a preliminary hazardous waste determination was developed as well as a list of detected radionuclides associated with the waste. Based on this review, the waste was compared to Envirocare's WAC. Primarily, the waste must be treated to meet the RCRA land disposal restrictions (LDR) concentration-based treatment standards for all applicable chemical constituents, and then stabilized prior to shipment and eventual disposal at Envirocare. Based on the present data no treatment for radionuclides will be required.

Conclusions and Recommendations:

1. Determine the activity of the liquid phase of the waste after on-site filtering and carbon absorption of the liquid phase of each tank waste to ensure compliance with Envirocare's WAC. Perform additional sampling and analysis if necessary.

2. Ensure waste was treated to meet applicable LDR requirements prior to stabilization and shipment to Envirocare.

3. Stabilize the liquid waste in a manner that minimizes volume increase as well as acceptable to Envirocare to manage as stabilized material.

Computer Source:

Compaq DeskPro with Microsoft Windows NT operating system and Office 2000 software.

ATTACHMENT 1 – REQUIRED TREATMENT TO ALLOW WATER TO BE SHIPPED TO ENVIROCARE

Required Treatment to Allow Water To Be Shipped to Envirocare

Based on Envirocare's Waste Acceptance Criteria (WAC) dated September 30, 1999:

- Envirocare is prohibited from accepting:
  - Radioactive waste classified as Class B or Class C waste
  - Radioactive waste in excess of the concentration limits per container for each radionuclide listed in its Radioactive Materials License.
  - Special Nuclear Material outside the limits of their SNM exemption certification.
  - Liquid radioactive waste
  - Solid radioactive waste containing free liquids
  - Bulk liquid wastes, non-aqueous liquids, or wastes with an organic liquid phase

- Envirocare's Radioactive Material License authorizes the receipt of radioactive waste in the form of soil or debris only.

- Envirocare can accept mixed waste for treatment using chemical stabilization (STABL), chemical oxidation (CHOXD), chemical reduction (CHRED), chemical deactivation (DEACT), neutralization (NEUTR), macroencapsulation (MACRO), and microencapsulation (MICRO).

- Radioactive mixed waste must meet the applicable land disposal restrictions or must be treated (using any of the specified methods listed above) prior to disposal on-site.

- For chemical fixation treatments, the waste must:
  - Must meet Envirocare's Radioactive Material License and RCRA Part B Permit.
  - Waste must be at or shreddable to a particle size of 3/8 inch.
  - Waste must not be subject to any other technology-based treatment standard.
  - Process is best for soils, sludges, and shreddable waste with little or no organics (<100 ppm).

- Envirocare requires third-party certified laboratory results prior to the approval of a waste stream and each laboratory must be Utah Certified for each method used to evaluate the waste stream.

Based on the above conditions, the water must be treated to meet the land disposal restrictions for each hazardous constituent present in the waste and the waste must be in a solid form prior to shipment to Envirocare. Therefore, the liquid waste must meet all applicable land disposal treatment standards prior to shipment and disposal at Envirocare.

Chemical Characterization

The following tables are for each chemical constituent associated with the liquid (water) phase of each tanks waste and the associated LDR treatment standard required by Envirocare's WAC, determined through the preliminary chemical characterization review based on existing analytical data provided by INEEL.

Note: The liquid phase of each tanks waste is considered a wastewater for purposes of complying with the land disposal restrictions, in that the liquid contains < 1% total organic carbon (TOC) and < 1% total suspended solids (TSS). The preliminary characterization was based on this assumption. If after removal of the waste from each tank, either the TOC or TSS exceed 1%, the waste must comply with the non-wastewater treatment standards also listed below.

Table 1. Tank V-1, Preliminary Liquid Phase Constituents Requiring Treatment			
Constituent (Waste Code)	**Concentration Detected in Waste (mg/L)**	**LDR Wastewater Treatment Standard (mg/L)**	**LDR Non-wastewater Treatment Standard (mg/kg)**
Antimony	1.9 (assumed)	1.9	1.15 mg/L
Lead (UHC)	0.84[J]	0.69	0.75 mg/L
Mercury (D009)	0.369	0.15 and meet §268.48 standards[1]	0.025 mg/L and meet §268.48 standards[1]
Chloromethane	0.19 (assumed)	0.19	30
Hexachlorobenzene	ND @ 1	0.055	10
Hexachlorobutadiene	ND @ 1	0.055	5.6
Tetrachloroethene (UHC)	0.14[J]	0.056	6.0
Trichloroethene (F001)	0.16[J]	0.054	6.0
UHCs (various)	See Table 5 for concentrations detected in Tank V-1 and applicable treatment standards.		
Additional process knowledge or re-analysis is required to determine if antimony, chloromethane and a majority of the SVOCs are considered underlying hazardous constituents (§ 268.48 standards) requiring treatment.			

[1] "§268.48 identifies universal treatment standards (UTS) for underlying hazardous constituents (UHCs) reasonably expected to be present at the point of generation at a concentration above the constituent-specific UTS treatment standards. For the liquid phase of Tank V-1, compliance with this standard has resulted in the identification of lead, antimony, chloromethane, tetrachloroethene and several SVOCs as UHCs, which are present at concentrations above the constituent-specific UTS treatment standard.

J = Estimated value
E = Exceeded calibration limit for instrument
R = Result rejected during validation and unusable
ND = Not Detected

Table 2. Tank V-2, Preliminary Liquid Phase Constituents Requiring Treatment			
Constituent (Waste Code)	**Concentration Detected in Waste (mg/L)**	**LDR Wastewater Treatment Standard (mg/L)**	**LDR Non-wastewater Treatment Standard (mg/kg)**
2,4-Dinitrotoluene	ND @ 1	0.32	140
Hexachlorobenzene	ND @ 1	0.055	10
Hexachlorobutadiene	ND @ 1	0.055	5.6
Trans-1,2-Dichloroethene	0.37[E, J]	0.054	30
Trichloroethene (F001)	0.3 [E, J]	0.054	6.0
UHCs (various)	See Table 5 for concentrations detected in Tank V-2 and applicable treatment standards.		

J = Estimated value
E = Exceeded calibration limit for instrument
R = Result rejected during validation and unusable
ND = Not Detected

Table 3. Tank V-3, Preliminary Liquid Phase Constituents Requiring Treatment			
Constituent (Waste Code)	**Concentration Detected in Waste (mg/L)**	**LDR Wastewater Treatment Standard (mg/L)**	**LDR Non-wastewater Treatment Standard (mg/kg)**
Chloromethane	0.01[R]	0.19	30
2,4-Dinitrotoluene	ND @ 1	0.32	140
Hexachlorobenzene	ND @ 1	0.055	10
Hexachlorobutadiene	ND @ 1	0.055	5.6
Trichloroethene (F001)	0.2	0.054	6.0
UHCs (various)	See Table 5 for concentrations detected in Tank V-3 and applicable treatment standards.		

J = Estimated value
E = Exceeded calibration limit for instrument
R = Result rejected during validation and unusable
ND = Not Detected

Table 4. Tank V-9, Preliminary Liquid Phase Constituents Requiring Treatment			
Constituent (Waste Code)	**Concentration Detected in Waste (mg/L)**	**LDR Wastewater Treatment Standard (mg/L)**	**LDR Non-wastewater Treatment Standard (mg/kg)**
Cadmium (D006)	1.9	0.69	0.11 mg/L TCLP and meets 40 CFR 268.48 standards[1]
Lead (D008)	0.942	0.69	0.75 mg/L TCLP
Mercury (D009)	0.563	0.15 and meets §268.48 standards[1]	0.025 mg/L TCLP and meets 40 CFR 268.48 standards[1]

Table 4. Tank V-9, Preliminary Liquid Phase Constituents Requiring Treatment			
Constituent (Waste Code)	**Concentration Detected in Waste (mg/L)**	**LDR Wastewater Treatment Standard (mg/L)**	**LDR Non-wastewater Treatment Standard (mg/kg)**
Nickel (UHC)	13.8	3.98	11 mg/L TCLP
Benzene (D018)	ND @ 17	0.14	10 and meets 268.48 standards[1]
Chloroform (D022)	ND @ 10	0.046	6 and meets §268.48 standards[1]
1,2-Dichloroethane (D028)	ND @ 25	0.21	6 and meets §268.48 standards[1]
1,1-Dichloroethene (D029)	ND @ 11	0.025	6 and meets §268.48 standards[1]
3,3 Dichlorobenzidene (Dibenz (a,h) anthracene (UHC)	ND @ 0.66	0.055	8.2
2,4-Dimethylphenol (UHC)	0.079	0.036	14
Indeno (1,2,3-cd) pyrene (UHC)	ND @ 0.036	0.0055	3.4
Methylene Chloride (UHC)	59.0[J]	0.089	30
2-Methylphenol (o-creosol) (UHC)	0.83[E]	0.11	5.6
4-Methylphenol (p-creosol) (UHC)	0.83[E]	0.77	5.6
Phenol (UHC)	0.1[E]	0.039	6.2
Tetrachloroethene (D039)	ND @ 17	0.056	6
1,1,1-Trichloroethane (UHC)	58[J]	0.054	6.0
Trichloroethene (F001)	410	0.054	6.0
Additional process knowledge or re-analysis is required to determine if a majority of the VOCs are considered underlying hazardous constituents (UHCs) requiring treatment.			

[1] "§268-48 identifies universal treatment standards (UTS) for underlying hazardous constituents (UHCs) reasonably expected to be present at the point of generation at a concentration above the constituent-specific UTS treatment standards. For the liquid phase of Tank V-9, compliance with this standard has resulted in the identification of lead, nickel, VOCs and SVOCs as UHCs which are present at concentrations above the constituent-specific UTS treatment standard."

J = Estimated value
E = Exceeded calibration limit for instrument
R = Result rejected during validation and unusable
ND = Not Detected

Table 5. SVOC Concentrations and Treatment Standards for Liquids in Tanks V-1, V-2, V-3, and V-9.						
	Concentration (mg/L)				LDR Treatment Standard for Wastewater (mg/L)	LDR Treatment Standard for Non-wastewater (mg/kg)
Constituent	V-1	V-2	V-3	V-9		
Acenaphthene	U (1)	U (1)	U (1)	U (0.006)	0.059	3.4
Acenaphthylene	U (1)	U (1)	U (1)	U (0.007)	0.059	3.4
Anthracene	U (1)	U (1)	U (1)	U (0.005)	0.059	3.4
Benzo (a) anthracene	U (1)	U (1)	U (1)	U (0.008)	0.059	3.4
Benzo (a) pyrene	U (1)	U (1)	U (1)	U (0.001)	0.061	3.4
Benzo (b) fluoranthene	U (1)	U (1)	U (1)	U (0.007)	0.11	6.8
Benzo (g,h,I) perylene	U (1)	U (1)	U (1)	U (0.003)	0.0055	1.8
Benzo (k) fluoranthene	U (1)	U (1)	U (1)	U (0.006)	0.11	6.8
Butylbenzylphthalate	U (1)	U (1)	U (1)	U (0.008)	0.017	28
Bis (2-chloroethoxy)methane	U (1)	U (1)	U (1)	U (0.008)	0.036	7.2
Bis (2-chloroethyl)ether	U (1)	U (1)	U (1)	U (0.007)	0.033	6
Bis (2-chloroisopropyl) ether	U (1)	U (1)	U (1)	U (0.006)	0.055	7.2
Bis (2-ethylhexyl) phthalate	**0.083 J**	**0.2 J**	**0.1 J**	0.038	0.28	28
4-Bromophenyl-phenylether	U (1)	U (1)	U (1)	U (0.007)	0.055	15
Chrysene	U (1)	U (1)	U (1)	U (0.008)	0.059	3.4
4-Chloroaniline (p-chloroaniline)	U (1)	U (1)	U (1)	U (0.027)	0.46	16
4-Chloro-3-Methylphenol (p-chloro-m-cresol)	U (1)	U (1)	U (1)	U (0.008)	0.018	14
2-Chloronaphthalene	U (1)	U (1)	U (1)	U (0.010)	0.055	5.6
2-Chlorophenol	U (1)	U (1)	U (1)	U (0.006)	0.044	5.7
Dibenz(a,h)anthracene	U (1)	U (1)	U (1)	U (0.005)	0.055	8.2
1,2-Dichlorobenzene (o-dichlorobenzene)	U (1)	U (1)	U (1)	**0.210E**	0.088	6
1,3-Dichlorobenzene (m-dichlorobenzene)	U (1)	U (1)	U (1)	U (0.006)	0.036	6
1,4-Dichlorobenzene (p-dichlorobenzene)	U (1)	U (1)	U (1)	0.049	0.09	6

Table 5. SVOC Concentrations and Treatment Standards for Liquids in Tanks V-1, V-2, V-3, and V-9.						
	Concentration (mg/L)				LDR Treatment Standard for Wastewater (mg/L)	LDR Treatment Standard for Non-wastewater (mg/kg)
Constituent	V-1	V-2	V-3	V-9		
3,3-Dichlorobenzidine (Dibenz (a,h) anthracene)	U (1)	U (1)	U (1)	U (0.066)	0.055	8.2
2,4-Dichlorophenol	U (1)	U (1)	U (1)	U (0.008)	0.044	14
Diethylphthalate	U (1)	U (1)	U (1)	U (0.008)	0.2	28
2,4-Dimethylphenol	U (1)	U (1)	U (1)	0.079	0.036	14
Dimethylphthalate	U (1)	U (1)	U (1)	U (0.007)	0.047	28
Di-n-butylphthalate	U (1)	U (1)	U (1)	U (0.003)	0.057	28
Di-n-octylphthalate	U (1)	U (1)	U (1)	0.006J	0.017	28
2,4-Dinitrophenol	U (5)	U (5)	U (5)	U (0.027)	0.12	160
2,4-Dinitrotoluene	U (1)	U (1)	U (1)	U (0.010)	0.32	140
2,6-Dinitrotoluene	U (1)	U (1)	U (1)	U (0.008)	0.55	28
Fluoranthene	U (1)	U (1)	U (1)	U (0.008)	0.068	3.4
Fluorene	U (1)	U (1)	U (1)	U (0.005)	0.059	3.4
Hexachlorobenzene	U (1)	U (1)	U (1)	U (0.007)	0.055	10
Hexachlorobutadiene (Hexachloro-1,3-butadiene	U (1)	U (1)	U (1)	U (0.010)	0.055	5.6
Hexachlorocyclopentadiene	U (1)	U (1)	U (1)	U (0.013)	0.057	2.4
Hexachloroethane	U (1)	U (1)	U (1)	U (0.008)	0.055	30
Indeno (1,2,3-cd) pyrene	U (1)	U (1)	U (1)	U (0.036)	0.0055	3.4
2-Methylphenol (o-cresol)	U (1)	U (1)	U (1)	0.830 E	0.11	5.6
4-Methylphenol (p-cresol)	U (1)	U (1)	U (1)	0.830 E	0.77	5.6
Naphthalene	U (1)	U (1)	U (1)	U (0.008)	0.059	5.6
2-Nitroaniline (o-nitroaniline)	U (5)	U (5)	U (5)	U (0.006)	0.27	14
4-Nitroaniline (p-nitroaniline)	U (5)	U (5)	U (5)	U (0.004)	0.028	28
Nitrobenzene	U (1)	U (1)	U (1)	U (0.009)	0.068	14

Table 5. SVOC Concentrations and Treatment Standards for Liquids in Tanks V-1, V-2, V-3, and V-9.						
	Concentration (mg/L)				LDR Treatment Standard for Wastewater (mg/L)	LDR Treatment Standard for Non-wastewater (mg/kg)
Constituent	V-1	V-2	V-3	V-9		
2-Nitrophenol (o-nitrophenol)	U (1)	U (1)	U (1)	U (0.007)	0.028	13
4-Nitrophenol (p-nitrophenol)	U (5)	U (5)	U (5)	0.037	0.12	29
N-nitroso-dimethylamine	---	U (1)	---	U (0.011)	0.4	2.3
N-nitroso-di-n-propylamine (Di-n-propylnitrosamine)	U (1)	U (1)	U (1)	U (0.013)	0.4	14
N-nitrosodiphenylamine (Diphenylnitrosamine)	U (1)	U (1)	U (1)	U (0.010)	0.92	13
Pentachlorophenol	U (5)	U (5)	U (5)	U (0.013)	0.089	7.4
Phenanthrene	U (1)	U (1)	U (1)	U (0.006)	0.059	5.6
Phenol	U (1)	U (1)	U (1)	**0.100E**	0.039	6.2
Pyrene	U (1)	U (1)	0.063 J	U (0.012)	0.067	8.2
Pyridine	U (1)	U (1)	U (1)	U (0.010)	0.014	16
1,2,4-Trichlorobenzene	U (1)	U (1)	U (1)	U (0.007)	0.055	19
2,4,5-Trichorophenol	U (5)	U (5)	U (5)	U (0.017)	0.18	7.4
2,4,6-Trichlorophenol	U (1)	U (1)	U (1)	U (0.010)	0.035	7.4

Notes:

1. Shaded boxes indicate UHCs where the detection limit is above the treatment standard and where the value recorded was below detection limits.

2. SVOCs without applicable treatment standards were not included in this table.

U = Not Detected (detection limit in parenthesis)
J = Estimated Value
E = Concentration exceeded the calibration range of the instrument

Radiological Characterization

The following tables identify only those radionuclides detected in the liquid phase of the waste from each tank, compared to the radionuclide limits as defined in Envirocare's Radioactive Material License, Amendment # 11, which expires on October 22, 2003.

Tank V-1, Preliminary Liquid Phase Radioactive Material		
Radionuclide	**Activity Detected (pCi/L)***	**Envirocare Waste Acceptance Criteria (Average Concentration per Container) (pCi/kg)**
U-233/234	1.89E+04 ±643	7.5E+07/3.7E+08
U-235	5.66E+02 ±21.8	1.9E+06[2]
U-238	2.1E+02 ±8.91	3.3E+08[3]
Pu-238	2.24E+02 ± 10.5	1.0E+07
Pu-239/240	1.05E+02 ± 6.64	1.0E+07/1.0E+07
Am-241	1.97E+02 ±9.21	1.0E+07
Cm-242	U (8.61)	2.0E+09
Cm-243/244	6.42E+01 ± 4.72	1.0E+07/1.0E+07
Np-237	U (26.7)	1.0E+07[3]
Sr-90	2.03E+06 ± 9010	2.5E+07[2]
Ag-108m	U (776)	5.0E+07[2]
Ag-110m	U (1270)	4.4E+11[2]
Am-241[1]	U (1350)	1.0E+07
Ce-144	U (7530)	4.4E+11[2]
Co-58	U (2160)	4.4E+11
Co-60	1.55E+04 ± 848	3.0E+07
Cs-134	U (734)	4.4E+11
Cs-137	2.9E+06 ± 134000	6.0E+07[2]
Eu-152	U (4860)	2.0E+07
Eu-154	U (1660)	3.0E+07
Eu-155	U (2420)	4.4E+11
Mn-54	U (755)	4.4E+11
Nb-95	U (2400)	NA
Ra-226	U (1260)	1.0E+07[2]
Ru-103	U (12900)	5.0E+05
Ru-106	U (9430)	4.4E+11[2]
Sb-125	U (3870)	4.4E+11[2]
U-235[1]	U (1340)	1.9E+06[2]
Zn-65	U (1730)	4.4E+11
Zr-95	U (4300)	4.4E+11
I-129	U (252)	3.1E+06
H-3	3.04E+07 ± 3160000	2.5E+10
Ni-63	2.88E+05 ±20700	2.2E+09

U = Not detected, detection limit given in parenthesis.

[1] Analysis by gamma spectroscopy

[2] Decay products are assumed to be present in concentrations equal to the parent.

[3] Short-lived decay products of U-238 (Th-234, Pa-234m and Pa-234); Np-237 (Pa-233); and Plutonium 244 (U-240, Np-240m, and Np-240) are assumed to be present in concentrations equal to the parent.

*It is assumed that the density of the liquid phase is close to the density of water and pCi/L is equivalent to pCi/kg.

Tank V-2, Preliminary Liquid Phase Radioactive Material		
Radionuclide	**Activity Detected (pCi/L)***	**Envirocare Waste Acceptance Criteria (Average Concentration per Container) (pCi/kg)**
U-233/234	3.86E+04 ± 1300	7.5E+07/3.7E+08
U-235	1.6E+03 ± 56.2	1.9E+06[2]
U-238	4.99E+02 ±17.6	3.3E+08[3]
Pu-238	4.75E+02 ± 17.3	1.0E+07
Pu-239/240	2.83E+02 ± 12	1.0E+07/1.0E+07
Am-241	5.89E+01 ± 4.88	1.0E+07
Cm-242	U (4.96)	2.0E+09
Cm-243/244	1.62E+01 ± 2.48	1.0E+07/1.0E+07
Np-237	U (27.6)	1.0E+07[3]
Sr-90	4.9E+06 ± 17400	2.5E+07[2]
Ag-108m	U (3960)	5.0E+07[2]
Ag-110m	U (7120)	4.4E+11[2]
Am-241[1]	U (15900)	1.0E+07
Ce-144	U (37800)	4.4E+11[2]
Co-58	U (1600)	4.4E+11
Co-60	1.3E+04 ± 799	3.0E+07
Cs-134	U (764)	4.4E+11
Cs-137	1.35E+07 ± 617000	6.0E+07[2]
Eu-152	U (4760)	2.0E+07
Eu-154	U (1820)	3.0E+07
Eu-155	U (14400)	4.4E+11
Mn-54	U (716)	4.4E+11
Nb-95	U (1960)	NA
Ra-226	U (4100)	1.0E+07[2]
Ru-103	U (36000)	5.0E+05
Ru-106	U (46200)	4.4E+11[2]
Sb-125	U (18400)	4.4E+11[2]
U-235[1]	U (6450)	1.9E+06[2]
Zn-65	U (1700)	4.4E+11
Zr-95	U (3210)	4.4E+11
I-129	U (169)	3.1E+06
H-3	1.02E+08 ±1.07E+07	2.5E+10
Ni-63	4.48E+05 ± 32300	2.2E+09

U = Not detected, detection limit given in parenthesis.

[1] Analysis by gamma spectroscopy

[2] Decay products are assumed to be present in concentrations equal to the parent.

[3] Short-lived decay products of U-238 (Th-234, Pa-234m and Pa-234); Np-237 (Pa-233); and Plutonium 244 (U-240, Np-240m, and Np-240) are assumed to be present in concentrations equal to the parent.

*It is assumed that the density of the liquid phase is close to the density of water and pCi/L is equivalent to pCi/kg.

Tank V-3, Preliminary Liquid Phase Radioactive Material		
Radionuclide	**Activity Detected (pCi/L)***	**Envirocare Waste Acceptance Criteria (Average Concentration per Container) (pCi/kg)**
U-233/234	1.33E+04 ± 443	7.5E+07/3.7E+08
U-235	4.01E+02 ± 15.2	1.9E+06[2]
U-238	1.35E+02 ± 5.97	3.3E+08[3]
Pu-238	3.83E+01 ± 3.35	1.0E+07
Pu-239/240	1.97E+01 ± 2.36	1.0E+07/1.0E+07
Am-241	3.18E+01 ± 3.16	1.0E+07
Cm-242	U (6.18)	2.0E+09
Cm-243/244	U (6.28)	1.0E+07/1.0E+07
Np-237	U (36.4)	1.0E+07[3]
Sr-90	1.23E+07 ± 21900	2.5E+07[2]
Ag-108m	U (343)	5.0E+07[2]
Ag-110m	U (906)	4.4E+11[2]
Am-241[1]	U (1780)	1.0E+07
Ce-144	U (3000)	4.4E+11[2]
Co-58	U (284)	4.4E+11
Co-60	1.48E+04 ± 829	3.0E+07
Cs-134	4.49E+02 ± 52.7	4.4E+11
Cs-137	4.23E+06 ± 195000	6.0E+07[2]
Eu-152	U (693)	2.0E+07
Eu-154	U (213)	3.0E+07
Eu-155	U (1170)	4.4E+11
Mn-54	U (106)	4.4E+11
Nb-95	U (319)	NA
Ra-226	U (332)	1.0E+07[2]
Ru-103	U (5640)	5.0E+05
Ru-106	U (4080)	4.4E+11[2]
Sb-125	U (1900)	4.4E+11[2]
U-235[1]	U (533)	1.9E+06[2]
Zn-65	U (237)	4.4E+11
Zr-95	U (549)	4.4E+11
I-129	U (108)	3.1E+06
H-3	6.09E+06 ± 633000	2.5E+10
Ni-63	2.05E+05 ±14800	2.2E+09

U = Not detected, detection limit given in parenthesis.

[1] Analysis by gamma spectroscopy

[2] Decay products are assumed to be present in concentrations equal to the parent.

[3] Short-lived decay products of U-238 (Th-234, Pa-234m and Pa-234); Np-237 (Pa-233); and Plutonium 244 (U-240, Np-240m, and Np-240) are assumed to be present in concentrations equal to the parent.

*It is assumed that the density of the liquid phase is close to the density of water and pCi/L is equivalent to pCi/kg.

Tank V-9, Preliminary Liquid Phase Radioactive Material		
Radionuclide	**Activity Detected (pCi/L)***	**Envirocare Waste Acceptance Criteria (Average Concentration per Container) (pCi/kg)**
U-233[1]	1.24E+04	7.5E+07
U-234[1]	2.11E+05	3.7E+08
U-235[1]	6.9E+03	1.9E+06[2]
U-236[1]	3.26E+03	3.8E+08
U-238[1]	9.72E+02	3.3E+08[3]
Pu-238	1.7E+05 ± 12900	1.0E+07
Pu-239/240	4.53E+04 ± 3690	1.0E+07/1.0E+07
Am-241	4.02E+04 ± 2500	1.0E+07
H-3	3.53E+08 ± 180000	2.5E+10
Cm-244	5.21E+03 ± 390	1.0E+07/1.0E+07
Np-237	2.0E+02 ± 36	1.0E+07[3]
Total Sr	4.9E+06 ± 17400	Each isotope separated
Co-60	1.18E+03 ± 59.4	3.0E+07
Cs-137	4.2E+05 ± 162000	6.0E+07[2]
Eu-152	5.66E+02 ± 37	2.0E+07
Eu-154	2.72E+02 ± 22.8	3.0E+07

[1] Analysis by inductively coupled plasma mass spectroscopy.

[2] Decay products are assumed to be present in concentrations equal to the parent.

[3] Short-lived decay products of U-238 (Th-234, Pa-234m and Pa-234); Np-237 (Pa-233); and Plutonium 244 (U-240, Np-240m, and Np-240) are assumed to be present in concentrations equal to the parent.

*It is assumed that the density of the liquid phase is close to the density of water and pCi/L is equivalent to pCi/kg.

Note: For waste containing more than one radionuclide, the waste must be classified by applying the sum of fractions rule as described in Envirocare's WAC. In addition, if this waste is expected to contain special nuclear material (SNM), additional limits and conditions will apply to this waste, which have not been discussed below.